DETERMINATION OF HERBICIDE RESIDUES IN EDIBLE TARO PARTS AND WETLAND FLOOD WATERS

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Abstract

A preliminary experiment with seven preemergence herbicides identified oxyfluorfen as a promising herbicide for commercial taro (Colocasia esculenta) production in Hawaii. Oxyfluorfen was applied twice at 0.38, 0.56 and 1.11 kg/ha to taro grown under wetland flooded and upland conditions. No oxyfluorfen residues were found in plant tissues (limit of detection 0.02 ppm). Oxyfluorfen levels in water from treated lowland plots was determined. Trace levels present in flood waters immediately after treatment dissipated to undetectable levels (limit of detection, 0.001 ppm) within 24 hours.

Introduction

Taro is a tropical crop grown for edible corms, leaves and stems. The natural habitat of taro is south-eastern Asia and Malaysia (3). In Hawaii, taro is generally classified into two distinct groups. Dasheen (Colocasia esculenta var. antiquorum) is grown for small edible auxiliary corms that are boiled and eaten. Dasheen was promoted by the USDA in 1910 as a promising wetland crop for the southern United States (4). Chinese taro (Colocasia esculenta var. esculenta) is grown in Hawaii for consumption of young leaves and edible main corm (derived from seed pieces). Large corms (3 to 4 kg) are the desired commodity for fresh market and chip production (deep fried slices, similar to potato chips). Taro grown under flooded conditions is cooked and ground into a thick paste (poi) and eaten.

In a preliminary experiment (unpublished data) in Hawaii, seven preemergence herbicides were evaluated on Chinese taro and dasheen. All treatments were applied at 0, 69 and 172 days after planting (DAP). All applications made after planting were directed to the base of plants. Metribuzin (0.6 and 1.1 kg active ingrediant (ai)/ha) caused unacceptable crop injury on Chinese taro which reduced yield. No herbicide treatments adversely affected dasheen yield, which is not in agreement with a previous report (5) showing crop injury with diuron. Short term (35-40 days) activity of diethatyl (2.3 kg ai/ha), pronamide (2.3 kg ai/ha) and metolachlor (2.3 kg ai/ha) prevented their inclusion in subsequent studies. Diuron (1.1 and 2.2 kg ai/ha) and thiobencarb (4.5 kg ai/ha) provided acceptable weed control with no crop injury. However, they were dropped from further study due to problems in obtaining legal use of these materials in the USA. Oxyfluorfen emerged from this study as the most promising herbicide for use in commercial taro production.

The objective of this research was to determine the bioaccumulation of oxyfluorfen in edible taro corms and leaves from plants growing in wetland flooded and upland soils. Oxyfluorfen in wetland flood waters was also determined.

Upland Taro Study

The experiment was conducted on Oahu at the University of Hawaii Waimanalo Research Farm on a Waialua stony silty clay (vertic haplustoll, 2% organic matter and pH 6.3). The experiment began on May 21, 1987. Taro (cv. `Niue') planting material consisted of an axial corm with a 25-30 cm petiole attached. An experimental unit was 2 m wide, 4.6 m long with a double row of taro (within row spacing was 0.5 m and between row spacing was 0.6 m). Oxyfluorfen was applied (7 and 98 DAP) at three rates; 0.38, 0.58, and 1.11 kg ai/ha. The control treatment consisted of hand weeding 25, 48, 70 DAP. Taro leaves and corms were sampled 186 days after the final herbicide application.

In all experiments, herbicides were applied in a spray volume of 350 l/ha at 125 kPa using flat fan spray tips (Spraying Systems Co. Wheaton, IL 61820, USA). Herbicide treatments applied after planting were directed to the base of plants on plots that were weed free. Fertilizer, irrigation and other pesticides were applied as needed for commercial crop production (6). Treatments were replicated four times using a randomized complete block design. Standard procedures (1,2,7) were used for quantifying oxyfluorfen in edible taro leaves, corms and water.

Wetland Taro Study

Oxyfluorfen in Corms:

Both experiments were initiated on the Kauai Rice Experimental Field on the island of Kauai. The soil type was Hanalei silty clay (tropic fluvaquent, 6.6 % organic matter at pH 4.6). Weeds in control plots were removed by hand to avoid competitive effects on the crop. On May 12, 1987, oxyfluorfen was applied to the soil of drained wetland plots (0 and 95 DAP) at three rates; 0.38, 0.56, and 1.11 kg/ha. An experimental unit consisted of enclosed plots (1.8 m wide and 6.1.m long) with a double row of taro (cv.`Lehua Maoli') spaced 0.3 m within the row and 0.6 m between rows. Plots were formed so that water could continuously flow through each plot without cross treatment contamination. Taro corms were sampled for residue analysis 282 days after the final herbicide application.

Oxyfluorfen in Exiting Paddy Flood Waters:

On Sept. 30, 1988, oxyfluorfen was applied (0 and 81 DAP) at 0.56, and 1.11 kg/ha. An experimental unit was 1.8 m wide and 6.1 m long and contained a double row of taro (cv.`Maui Lehua'). Immediately after the second herbicide application flood waters entered treated plots. Water exiting treated plots was sampled 0 and 24 hours after herbicide application. At collection time, samples were passed through a clean sheet of filter paper (D.B. Eaton-Dikeman Co. Filter Paper, 533 cm. grade 615) supported by a stainless steel funnel into glass bottles wrapped with aluminum foil.

Results and Discussion

Two applications of oxyfluorfen on taro grown under upland and flooded wetland cultivation did not result in detectable bioaccumulation in edible leaves (dryland only) or main corms. These data will support the legal use of oxyfluorfen for upland taro production in Hawaii. Oxyfluorfen applied to lowland soil caused trace levels in water exiting plots 0 hours after application (Table 1.), at 24 hours none were detected. Due to strict rules governing pesticides in moving water, trace levels of oxyfluorfen in exiting flood water will preclude legal (in USA) use on lowland taro in the manner documented here. Research will be initiated to develop a wetland cultural practice which will prevent detectable levels of oxyfluorfen in waters leaving treated lowland soils.

Table 1. Oxyfluorfen Concentration in Flood Waters Exiting Treated Lowland Flooded Taro Plots at 0 and 24 Hours After Application[1].

Treatment	Rate (kg ai/ha)	Oxyfluorfen Conc.[2] (ppm)	
		0 Hours	24 Hours
Untreated control	-	ND	ND
Oxyfluorfen	0.38	.008	ND
Oxyfluorfen	0.56	.009	ND

Notes:
ND = None detected
[1] Mean of four replications.
[2] Limit of detection in flood water was 0.001 ppm.

Literature Cited

Adler, I.L. and C. K. Hofmann. 1980. Oxyfluorfen (Chapter 17), in Analytical Methods for Pesticides and Plant Growth Regulators, vol. XI, eds. G. Zweig and J. Sherma. Academic Press.

Adler, I.L., L.D. Haines and B. M. Jones: 1978. Gas-Liquid chromatographic determination of residues from the herbicide 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene. J. Assoc. Official Anal. Chem: 61:636.

Allen, E. F. 1940. The cultivation of Colocasia esculenta (L.) Schott. in Malaya. Malaysian Agr. J. 28:392-399.

Barrett, O. W. and O. F. Cook. 1910. Promising root crops for the South. U.S. Dept. Agri., Bur. Pl. Ind., Bull No. 164.

Kasasian, L. 1967. Chemical weed control in tropical root crops. Trop. Agr. Trin. 44:143-150.

Mitchell, W. C. and P. A. Maddison, 1983. Pest of Taro. Pages 180- 235 in J-K. Wang, ed. Taro, A review of Colocasia esculenta and its potentials., University of Hawaii press, Honolulu.

Pesticide Analytical Manual, vol. II, oxyfluorfen, pesticide reg. sec. 180.381, U.S. Dept. of Health and Human Services, Food and Drug Administration, revised September 1983.

The Library of Congress has catalogued this serial publication as follows:

Research Extension series / Hawaii Institute of Tropical Agriculture and Human Resources.—001— [Honolulu, Hawaii]:
The Institute, [1980–
v. : ill. ; 22 cm
Irregular.
Title from cover.
Separately catalogued and classified in LC before and including No. 044.
ISSN 0271-9916 = Research Extension Series - Hawaii Institute of Tropical Agriculture and Human Resources.
1. Agriculture—Hawaii—Collected works. 2. Agriculture—Research—Hawaii—Collected works. I. Hawaii Institute of Tropical Agriculture and Human Resources. II. Title: Research Extension Series - Hawaii Institute of Tropical Agriculture and Human Resources.
S52.5R47 630'.5—dc19 85-645281
AACR 2 MARC-S
Library of Congress [8506]